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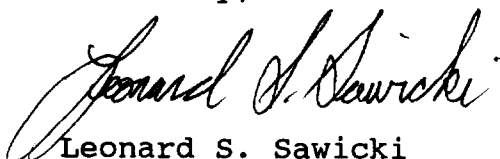# EX PARTE

January 26, 1994

Mr. William F. Caton
Secretary
Federal Communications Commission
Room 222
1919 M Street NW
Washington, D.C.   20554

     Re: <u>PP Docket No. 93-253</u>

Dear Mr. Caton:

Today, Dr. Peter Cramton of the University of Maryland, Larry Blosser of MCI, and I met with John Williams, Jonathan Cohen, Don Gips, Kent Nakamura and Evan Kwerel of the Office of Plans and Policy. The purpose of the meeting was to review Dr. Cramton's recommendations on the design of the PCS spectrum auction. The attached paper was distributed at the meeting.

Sincerely,

Leonard S. Sawicki

Attachment

cc: Mr. Cohen
     Mr. Gips
     Mr. Kwerel
     Mr. Nakamura
     Mr. Williams

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Comments on the Design of the PCS Spectrum Auction
Professor Peter Cramton
University of Maryland
25 January 1994

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Summary

The FCC's goal in allocating the PCS spectrum is to maximize social welfare. This goal is best served by adopting an auction design that maximizes competition in the PCS, cellular, and local exchange markets. To this end, the Commission should adopt auction rules that promote entry by new firms capable of competing with incumbents.

The auction rules should encourage the formation of a national license whenever a national license is efficient. Rules that do not allow for a national license are biased against a national aggregation, because of strategic hold out and aggregation risk. Hence, national bidding should be allowed. To encourage aggressive national bidding, premium bids (a percentage increase over the sum of the regional bids up to some maximum) should be permitted. Moreover, the regional rules should be designed to encourage regional bidding by those submitting national bids. The main argument against national bids, the free rider problem, has been overemphasized. When it exists there are countervailing biases working against a national aggregation.

The eligibility restrictions on incumbent firms serve an important function in promoting post-auction competition. Bidders should be required to demonstrate their eligibility at the time the auction begins. Allowing bidders to qualify after the auction enables bidders to circumvent the intent of the restrictions.

The rules should guard against collusion both during and after the auction. When bidders are unconstrained, auction outcomes are biased toward more collusive industry structures. Strict eligibility restrictions are needed to reduce this problem. In addition, the identities of active bidders should remain hidden. Revealing identities facilitates collusion and other forms of strategic manipulation.

The auction design should encourage efficient aggregations, promote the flow of information, and give the bidders opportunity to revise strategies in light of new information. The pace of the auction should be set to balance the cost of delay with the benefit of improved bidder behavior.

I have been asked by MCI Telecommunications Corporation (MCI) to comment on the design of the PCS Spectrum Auction to be conducted by the FCC this spring. In preparing these comments, I have reviewed comments and reply comments on the NPRM concerning auction design, especially those by economic experts. I am Associate Professor of Economics at the University of Maryland. My research specialty is economic exchange in markets with few parties. My work on auctions, bargaining, and industrial organization has been published in leading economics journals. (A copy of my vita is attached.)

The Commission has received many suggestions from auction experts. Several of the experts present workable designs for the PCS auction. An artful blending of the best ideas presented should yield a highly efficient allocation of the PCS spectrum and enormous gains to the public.

Rather than repeat all the issues discussed at length in the earlier comments, I have chosen instead to highlight a few of the issues that have been given too little attention. The central theme of my comments is that the public interest is best served by designing the auction so as to maximize post-auction competition in telecommunication markets.

1 The structure of the post-auction PCS market is of paramount importance.

Many of the comments rely on the assumption that the fundamental goal of the auction is to allocate the licenses to the parties that value them the most. This certainly is an important objective for auctions of consumption goods. However, the auction of licenses is substantially different. The allocation of licenses will determine the competitiveness of the industry, which will greatly influence consumer welfare.

I suspect that many of the better design alternatives being considered by the FCC will generate comparable revenues, and lead to allocations that are roughly efficient in terms of firm values. However, what will have the greatest impact on long run social welfare is the auction's impact on the competitiveness of the telecommunication industry.

Competitiveness is an issue at three levels: (1) the market for PCS, (2) the cellular market, and (3) the local exchange. Consumers will be best served if PCS spectrum is used to foster competition within all three markets. The linkages among these markets is what makes the PCS allocation so important to consumer welfare.

As stated in a recent *Telco Business Report* (October 11, 1993), "PCS has an unparalleled potential for stirring up the [telecommunication] industry." This potential, however, will only be realized if the spectrum allocation introduces new entrants into the wireless market — strong entrants that are able to compete with the incumbent cellulars and LECs. The need for new entrants stems from the fact that the existing players have less of an interest in competing aggressively.

The dominant cellular firms and LECs are unlikely to use the PCS spectrum in ways that will compete with their existing operations. For this reason, cellular incumbents have been limited in the amount of spectrum that they can acquire in markets in which they currently operate. Even in markets outside their existing markets, the dominant cellulars and LECs may have a reduced interest in aggressive competition as a result of multimarket contact. (See B. Douglas Bernheim and Michael D. Whinston, "Multimarket Contact and Collusive Behavior," *Rand Journal of Economics*, 21, Spring 1990, pp. 1-26.)

2 The formation of a national license should not be discouraged.

Not surprisingly, many firms that are ineligible for a national license because of their current cellular interests have opposed nationwide bidding. These firms and their experts have argued that national bidding is both inefficient and unnecessary. Both arguments depend on tenuous assumptions about bidder values, bidder behavior, and the auction design. Indeed, bidders attempting to bid for a nationwide service face obstacles that may prevent a national aggregation even when social welfare is served best by a nationwide service.

Unfortunately, no auction design will be free of biases. The best the Commission can do is adopt a design that includes competing biases that level the playing field. In striking a balance, the Commission should keep in mind the potential desirability of a national license. In the next section, I will consider the desirability of a nationwide license, and then I will turn to the potential biases for and against a national aggregation in the proposed auction designs.

2.1 A national license is socially desirable.

The experience with cellular licenses is most telling in evaluating the desirability of a national license for PCS. Over the last ten years, resale of cellular licenses by non-LEC license holders has been substantial. The tendency for increasing aggregation is underscored by the formation of two cellular national brands. There are significant customer benefits from a nationwide service, such as interoperability and improved roaming capabilities.

More importantly, strong nationwide competitors are more apt to provide an effective competitive check on the dominate cellular carriers and LECs. Indeed, without national competitors, it is likely that most of the PCS spectrum will be acquired by the incumbent cellulars and LECs. Such an outcome would likely be less competitive than the outcome with national competitors. National competitors would be new entrants without conflicting cellular or local exchange interests. A national competitor would have the scale economies and resources for product innovation. Rapid build-out would be facilitated, because any network externalities present with splintered licenses would be internalized with a national aggregation. Rather than being anticompetitive, it is likely that a national license would

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encourage competition. Moreover, this competition would be felt not only in the PCS market, but in the cellular duopoly and the local exchange monopoly. Indeed, the largest consumer gains are likely to derive from increased competition in these highly concentrated markets.

Others have argued that most of the value of a nationwide service can be obtained with a near national service. They argue that the loss of one or two MTAs would have only a marginal impact on the synergies offered by a national service. Depending on *which* MTA is lost, this may or may not be a marginal change. All of the proposed auction designs that do not allow national bids expose national bidders to a substantial risk of acquiring licenses that fall far short of a nationwide service. Even the loss of a single MTA, such as New York (11% of the nation's population) or Los Angeles (8%), could undermine a nationwide strategy. (The Pioneer Preference awards of New York, Los Angeles, and Washington MTA licenses make such a loss all the more likely.) Without New York, a national bidder may have to abandon key features of a nationwide strategy, such as the use of national promotion and advertising channels. National television may be infeasible with the loss of only a few large MTAs. This problem is aggravated if the national strategy depends on high adoption rates and extensive build-out. It is not in the public interest to discourage such strategies. These strategies are apt to create the greatest consumer surplus by enhancing competition in telecommunication markets other than PCS.

2.2 The free-rider bias favoring national bidders is overemphasized.

All opponents to national bidding have emphasized the free-rider problem that results with combinatorial bidding. They argue that if national combinatorial bids were allowed, the national bidders would have the opportunity to outbid the regional bidder, but the regional bidder, because of the free-rider problem, would not have the same opportunity to outbid the national bidders. (Throughout, I use the term "regional" to refer to either MTAs or BTAs.) Each regional bidder would prefer to have the bidders in other regions make the raises needed to outbid the top national bid. However, this argument only makes sense if the national auction is held after or simultaneous with the regional auctions.

If the national auction is held before the regional auctions, the national bidders are not given the opportunity to top the regional bids, since the national bidders do not know the winning regional bids. When a national auction precedes ascending bid auctions for regional licenses, the first-price from the national auction is compared with the sum of the second-highest values revealed in the regional bidding. If the regional bidders could coordinate their bids and overcome the free-rider problem, the regional bidders in fact would be at an advantage. The regional bidders then would be able to exceed the first-price in the national auction whenever the sum of the highest regional values exceeds the national first-price, assuming the national first-price is announced.

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Even if we assume that the free-rider problem cannot be overcome, there is a net bias against national bidders. First, the number of bidders at the regional level is likely to be large. This means that the difference between the first and second highest values at the regional level is likely to be small. (In standard auction models, the difference between the highest and second highest values falls to zero as the number of bidders grows.) In this case, the smallest winning national bid would have to nearly beat the sum of the highest regional values. Second, the proposed design (national auction then regional auctions) compares the highest *bid* from the national auction to the sum of the highest bids (assumed to be the second-highest *values*) at the regional level. The highest national *bid* is likely to be below the highest national *value*. National bidders would have to shade their bids to avoid the winner's curse. They know that if their bid is successful, it is because they overestimated the value more than everyone else. They, therefore, must reduce their bid to avoid a loss. Since the amount of common uncertainty is large at the time of the national auction, the winner's curse is likely to be severe. In this case, the highest national value could exceed the sum of the highest regional values and still lose. Using a second-price auction in the national auction would reduce this problem. However, this would increase the chance that the licenses would go to a national bidder when the regional bidders have higher values.

Experts Nalebuff and Bulow propose putting the national auction on "equal footing" with regional auctions by letting both be ascending bid auctions. Then the second-highest values from each auction are compared. This proposal goes too far in favor of regional bidding, because the national and regional auctions are in fact *not* on equal footing. First, the national auction is likely to have fewer bidders than the regional auctions; hence, the difference between the first and second highest values in the national auction is likely to be much larger than in the individual regional auctions. A national bidder facing inadequate competition at the national level is unable to raise its bid in anticipation of regional competition. Second, as Nalebuff and Bulow point out, the regional bidders would have observed the outcome of the national auction (and any earlier regional auctions), and would be in a much better informational position than national bidders. Regional bidders face less common uncertainty and so can bid more aggressively.

There is no compelling evidence that national bidders have an advantage when the national auction is held before the regional auctions. Indeed, just the opposite is likely the case. Any advantage from the free-rider problem is almost surely dominated by the bias stemming from the national bidders' informational disadvantage. Thus, the FCC's original proposal of a sealed-bid national auction followed by regional bidding probably favors regional bidders, not national bidders.

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2.3 Premium national bids should be allowed, so as to encourage aggressive national bidding.

In light of the substantial informational disadvantage faced by national bidders, it is likely that national bidders would be unable to compete with regional bidding — not because a national license is inefficient, but because national bidders are forced to substantially shade their bids to avoid the winner's curse. A solution to this problem has been proposed by NYNEX: allow national bids to be entered as premiums above the sum of the regional bids up to some maximum. For example, a bidder could submit a sealed bid for a national license at 5% above the sum of the regional bids up to a maximum of $3 billion. Such a bid enables national bidders to condition their bids on information revealed in the regional auctions. The bid may be $3 billion if bidding at the region level is surprisingly active, which reveals to the national bidder that it probably underestimated the true value of the license. Alternatively, the bid may be less if the regional bidding is weaker than what the national bidder expected.

Allowing premium bids at the national level will increase revenues. With premium bidding, the national bidders are able to bid more aggressively, since the winner's curse is reduced. Premium bids are especially attractive in a common value setting with aggregation synergies. An efficient national aggregation would form, even with substantial common value uncertainty.

A potential problem with premium bids is that they may aggravate any free-rider problem. Premium bids to some extent allow national bidders to top the regional bids, although regional bidders do not have the same opportunity. However, national bidders still must set the premium bid at a time when they have little information. Hence, national bidders must take care not to set their premium bid maximums too high. The free-rider problem is likely offset by the informational disadvantage of the national bidders.

2.4 Regional bidding by those submitting national bids should be encouraged.

Assuming the national auction precedes regional auctions, it will be important to encourage national bidders to participate in regional auctions. One way to encourage national bidders is to open the national bids before regional bidding. This assures full participation by all but the highest national bidder. The national winner's bidding in the regional auctions, however, will be somewhat chilled. In deciding whether to bid aggressively on a regional license, the national winner must include as a cost the possibility that the aggressive bidding will raise the sum of the regional bids above the national winning bid.

This problem is corrected by comparing the winning national bid with the sum of what the regional bids would have been had the national winner not bid at the regional level. With sealed bidding at the regional level, this would mean that on all licenses that the national

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winner wins at the regional level, the second highest price, rather than the highest price, should be used in determining the sum of the regional bids. In this way, the national winner is not penalized for aggressive regional bidding. Another advantage of this method is that it no longer is necessary to reveal the outcome of the national bidding before the regional bidding. Each national bidder can bid aggressively in the regional auctions, knowing that its regional bidding will not increase the sum of the regional bids should it win the national auction.

2.5 Auction proposals without national bidding bias outcomes against the formation of a national license.

Without national bidding, the spectrum auction will be biased against the formation of a national license. This bias against a national license is present, regardless of whether the regional licenses are auctioned in a sequential or simultaneous fashion. There are two main biases: (1) the holdout problem familiar from real-estate development and (2) aggregation risk.

2.5.1 Without a national auction, strategic hold out will make forming an efficient national license difficult.

When Disney decided to build a new theme park, Disney America, it sent a team of cleverly disguised buyers to gradually buy or (preferably) acquire options to buy the needed real estate. The deception was necessary to avoid strategic hold out by the landowners. If Disney's plans were known, every landowner would have an incentive to hold out until the end and bargain with Disney over the aggregation gains derived from acquiring the last piece. Disney would be unable to buy the land at current market prices. Indeed, it would be unlikely that Disney could obtain the land even at prices that give the entire aggregation gain to the land owners. This problem of strategic holdout is present in virtually every large real estate transaction requiring multiple acquisitions.

Although strategic holdout is most severe in all-or-nothing situations in which the aggregation gain is lost if any one piece is missing, it is still present in less extreme settings. As discussed above, the likely aggregation gains in the PCS market are not all-or-nothing. However, the loss of a few large MTAs could result in substantial synergy losses.

Strategic holdout in the PCS auction arises when one or more firms bid up a license beyond their individual valuations. They do so knowing that the license represents a key piece of a national aggregation. The firms are willing to bid more for the piece, not because they value it more, but because they are confident they will be able to sell it profitably to the national bidders in the resale market. This behavior limits the amount of aggregation gains that the national bidders can capture. Hence, it discourages the formation of an efficient

national license. Why should national bidders attempt to form a national license if they cannot reap the gains from the effort?

To see how strategic holdout could occur, suppose a national bidder has succeeded in acquiring all but one key piece. This was accomplished by bidding aggressively — bidding with confidence that the national aggregation would succeed. The question is how much this last key piece will sell for. The national bidder's valuation of the last piece is inflated by the total aggregation gain. The fact that most of this gain has already been spent in prior acquisitions is irrelevant — those costs are sunk. The other bidders, recognizing the national bidder's dilemma, are willing to continue bidding beyond their valuations, so long as they are confident they can sell the license to the national bidder at a higher price in the resale market. Of course, resale will not actually be necessary, since the national bidder will continue to bid up to its reservation price. But by doing so, the national bidder has possibly bid well beyond the aggregated value. Aware of this possibility, national bidders may view the chance of reaping even a small share of aggregation gains as hopeless.

2.5.2 Without a national auction, aggregation risk will prevent national bidders from forming an efficient national license.

Proponents of simultaneous auctions have argued that they make a national auction unnecessary. Certainly, an advantage of a simultaneous auction is that firms will have a better idea of what aggregations will be profitable: bidders can observe the high bids across licenses before committing to an aggregation. Simultaneous auctions offer better information across licenses, making efficient aggregations more likely. While this is true to some extent, the information about prices remains imperfect until the auction actually closes.

Consider the example of a national bidder that takes the advice of experts Milgrom and Wilson and lays low until "prices have substantially stabilized." (Given the activity rules proposed by Milgrom and Wilson, which are essential to guaranteeing that the auction comes to a timely end, a national bidder may be unable to wait until "prices have substantially stabilized.") The national bidder then calculates that, given the synergies of a national aggregation, it can safely top all the current high bids. It bids for a national aggregation. At this point, the national bidder finds that several regional bidders were laying low as well. A few key regions continue to be bid up beyond what the national bidder can tolerate. The national bidder is left holding all the licenses that were relatively overpriced at the time that it entered. Alternatively, the national bidder may continue to bid upward beyond its valuation hoping that the others will drop out, and knowing that if it stops now it will be left with the dogs, but not the aggregation gains. This scenario will prevent the national bidder from bidding on aggregation gains unless it is confident the aggregation will be achieved.

Unfortunately, such confidence can only come too late. It is too easy to pay for the aggregation gains and yet fail to achieve the aggregation.

This problem of aggregation risk is reduced if high bidders can withdraw their bids at low cost, as proposed by PacTel and its expert McAfee. This would be a sensible means of reducing aggregation risk, so long as the cost is high enough to prevent insincere bidding. There is the possibility that a few withdrawals may trigger a cascade of additional withdrawals. However, such a cascade surely would be limited, as winning bids become more attractive with each withdrawal. Modest withdrawal penalties will encourage bidders to bid for aggregation gains. Modest withdrawal penalties are especially important for small bidders facing budget constraints.

Sequential bidding does not avoid the problem of aggregation risk. National bidders must guess what later licenses will sell for in deciding whether to pursue a national aggregation. Should a bidder assume that the aggregation will be successful and include the aggregation gains in its assessment of value? Such a strategy would be foolhardy. National bidders must discount their bids in line with the probability the aggregation will fail.

The difficulties of forming an efficient aggregation can be seen from a simple example. Suppose there are ten bidders for a single license in each of twenty regions. For each regional license, each bidder has an unbiased, independent, normally distributed signal of the common value of the license. Further suppose that the twenty licenses are sold in a simultaneous sealed-bid auction and that all signals are equally precise. Without any aggregation gains, each bidder discounts the signal by an amount that depends on the number of bidders and the precision of the signals, so as to avoid the winner's curse. By symmetry, the probability of winning an individual license is 1 in 10, and by independence, the probability of winning all the licenses is $(1/10)^{20}$. Now suppose there are aggregation gains of 20% if a bidder is able to acquire all the licenses. How should this change the bidding behavior? The answer is not much. It is almost impossible to win all the licenses, assuming that the variance of the signals is such that signals often differ from the true values by more than 20%. One of the most basic rules of bidding strategy is that substantial increases in the probability of winning can only be achieved with even more substantial losses. The mathematics of the winner's curse would almost surely prevent a national aggregation. Hence, bidders should bid accordingly and not modify their bids, realistically assuming that they will be unable to capture the aggregation gains.

This is an extreme example to present the aggregation problem in its starkest form. The problem is reduced if there is correlation across licenses or if an ascending bid auction is used instead of sealed bids. Nonetheless, the problem is real and unavoidable without national bidding. Because of the winner's curse, it is almost inconceivable that national bidders could

form a national aggregation without a national auction, even when there are substantial gains from forming a national aggregation.

3 The possibility of collusion should not be ignored.

Most experts have discounted the possibility of collusion in the spectrum auction. They argue that, given the severe penalties, management is unlikely to engage in explicit collusion. Moreover, they argue that the number of bidders will be sufficiently large to exclude most forms of tacit collusion. Although I agree that collusion is unlikely, I think it would be dangerous to dismiss the possibility altogether. In addition, even if collusion in the auction is unlikely, collusion in the post-auction market remains a legitimate concern. Because of rent seeking behavior, the possibility of post-auction collusion will bias auction outcomes. Without adequate eligibility restrictions, auction outcomes will favor more collusive industry structures.

To see this point, consider a market with two blocks of spectrum, A and B. Suppose the market has a single incumbent that is operating as a monopolist on block A. Block B is up for auction. The incumbent would have a significant advantage in the auction for block B, because, other things being equal, the incumbent's value is higher than the values of other bidders by the difference between monopoly and duopoly profits. The outcome of the auction (monopoly) would be efficient in the sense that the bidder with the highest value wins, and yet inefficient in that social welfare is not maximized. Clearly, in this extreme case, the incumbent should be excluded from the bidding. The incumbent's value is artificially inflated by the monopoly rents it is able to capture by controlling both blocks.

Now replicate the scenario above so there are two markets, each with two blocks of spectrum, A and B. Each market has a monopolist incumbent operating on block A. Block B is up for auction in both markets. For antitrust reasons described above, the incumbents are excluded from bidding in the market in which they operate. Although this antitrust exclusion protects against outright monopoly, the outcome of the auction is still biased toward collusion. All else equal, the incumbent bidders will value the block in the other market more than a bidder that is not an incumbent in either market. The incumbents' values for the B blocks are inflated to the extent that multimarket contact increases opportunities for collusion.

One source for collusive gains comes from a firm's decision on how to use the PCS spectrum. PCS can be used in different ways. A competing duopolist will use the spectrum in the manner that yields the highest profits, irrespective of how the use affects the incumbent's profits. But if each incumbent acquires block B in the other's market, they can tacitly agree to use the block B spectrum in the other's market in a way that is less destructive to the

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incumbent's profits. Collusion is enhanced by the multimarket contact, because a firm that acts competitively in the new market can be punished in both markets.

This bias toward collusive industry structures is independent of collusion in the auction itself. Even if the bidders are bidding competitively, they will recognize that the value of the license depends on the post-auction industry structure and bid higher for more collusive structures. The bias can be corrected by imposing further eligibility restrictions that discourage multimarket contact.

The opportunities for post-auction collusion in the PCS market are more complex than in the simple example above. Each PCS market will have at least three licensees. This may make the sort of collusion described above more difficult, but it also increases the potential gain from collusion.

The most collusive PCS structure is probably one in which the incumbent cellular carriers and LECs dominate PCS through a web of interconnected markets. Collusion of this sort is enhanced by the strong industry groups that exist in the cellular market.

The main conclusion to draw is that new entrants into the wireless markets should be encouraged. Strong new entrants are much more apt to "stir up" the cellular and local exchange markets.

4 Eligibility restrictions should not be relaxed.

From a social welfare point of view, it is more important to encourage competition in the post-auction market than to encourage competition in the auction itself. This is the base for the eligibility restrictions in the FCC's current plans. Any modest gain in auction revenues that results from weakening the eligibility restrictions is likely to be dominated by the loss of consumer welfare resulting from reduced competition in the post-auction market.

Eligibility restrictions are the safest and most direct means of correcting for the collusion bias discussed above. Only by excluding incumbent firms from some licenses can the FCC be confident that the auction winners' higher values are not attributable to collusive rents.

Even seemingly benign relaxations of the eligibility rules, such as allowing firms to resolve conflicts of interest after the winners are announced, should be considered with caution. In this scenario, an incumbent cellular firm that won a large block of PCS in its cellular market would have to sell its cellular license. The problem with this is that the incumbent has an interest in selling the license to a firm that offers the least threat of competition. Hence, the conflict of interest is not fully resolved through the sale of the firm, since the incumbent can decide to whom it sells the license. Of course, the incumbent could make the friendly sale ex ante (before the auction), but the incumbent will have much better information about who is friendly once the licenses have been allocated. Resolving conflicts

ex post has further problems, such as late withdrawals by winners who are unable to resolve conflicts, and the potential for costly and time-consuming litigation over whether conflicts have been resolved. Given these difficulties, the FCC is wise in adopting a clear, ex ante eligibility rule. Bidders should have to demonstrate their eligibility at the time of the auction.

5 The identities of active bidders should remain hidden until a winner is announced.

Revealing the identities of the bidders during the auction has one advantage. It reveals more information to the bidders, helping them make value assessments and reducing the winner's curse. Revealing identities, however, has a number of disadvantages, which stem from the possibilities for strategic manipulation.

5.1 Revealing identities fosters collusion in the auction.

Although explicit collusion in the auction is unlikely, it remains a possibility. Less extreme forms of tacit collusion are even more likely. Revealing identities of active bidders facilitates all forms of collusion within the auction. Collusive schemes must be supported by a system of punishments in the event of deviations from the scheme. Observing the identities of active bidders makes it much easier to detect deviations and to direct punishments at defectors once detected. The ability to inflict quick and harsh punishments on defectors greatly enhances the opportunities for collusion.

5.2 Revealing identities fosters post-auction collusion.

A more serious form of collusion in the PCS auctions is behavior intended to enhance post-auction collusion. Incumbent cellular carriers and LECs would benefit from encouraging friendly "competitors" to win PCS licenses. In its simplest form, this strategy might be called "I'll buy yours, if you'll buy mine." Such a strategy facilitates post-auction collusion through multimarket contact. Revealing identities, especially in simultaneous auctions, aids this form of collusion. Of course, since there will be at least three license holders in every region, several parties must be involved in the arrangement.

Consider just one of the many possibilities. Suppose the incumbents agree that new entrants in the market are undesirable. They resolve that the dominant carriers should acquire as much of the spectrum as possible. The question is how best to achieve this goal given that they have differing values for the various licenses? It is suggested that each incumbent that finds itself bidding against a new entrant (all other incumbents have dropped out) bears the "group responsibility" to continue the bidding. In this way, the highest valuing incumbents will win the auction, and new entrants will be kept out. The key to this collusive strategy is

being able to identify when you are bidding against an insider (incumbent) and when you are bidding against an outsider (new entrant). This is only possible if identities are revealed.

A weaker form of this scheme is simply "bid more aggressively against unfriendly competitors." Observing the identities of the active bidders is essential to this strategy.

5.3 Revealing identities fosters strategic hold out.

With identities revealed, it is easier to observe when a valuable aggregation is nearly formed. Bidders can then jump into the bidding in an effort to steal a portion of the aggregation gain.

5.4 The gains from revealing identities may be small.

It is not immediately obvious why substantial informational gains should result from revealing identities. Identities would be important if they revealed large (ex ante) asymmetries in valuations or in the precision of each bidder's information.

Even if ex ante asymmetries are great, the FCC has more direct means of reducing the winner's curse. For example, in the coming months, the FCC could compile a list of information sources. Basic census information at the MTA and BTA levels could also be made available to bidders. This has the additional advantage of leveling the playing field for small bidders that do not have the resources to invest heavily in information. Otherwise, large bidders are apt to have a informational advantage. Any costs borne by the government in collecting and disseminating information would almost certainly be recouped through higher auction revenues.

Identities are also important when one firm's valuation depends on who owns the other licenses in a region. Such a dependence may exist, because different firms will make different uses of the spectrum. However, this is precisely the situation in which concern for collusion is the greatest.

On balance, it would seem better to hide the identities of active bidders. Revealing bidder identities introduces the possibility of substantial losses through collusion both during and after the auction.

6 The auctions should conclude in a timely fashion, yet allow opportunity for incorporating new information.

A significant challenge facing the FCC is settling on an auction design that has the right pace. It is important that the auction conclude in a timely fashion, but at the same time, bidders must have time to incorporate new information and revise strategies in light of it.

Several features of the spectrum auction imply that some amount of simultaneity is essential, at least at the BTA level. First, there are 2,559 licenses to be allocated. (This is about 100 per day if the auctions finish in a month.) Second, the auctions should be open ascending bid to reveal as much information during the auction as possible. And third, given the dollar magnitudes involved, a day is probably needed to evaluate new information. This would give the bidders time to go back to top management and revise strategies. Several minutes, or even hours, would be inadequate. Combining these three features, it is clear that some amount of simultaneity is needed if the auctions are to finish in a reasonable amount of time say, one month.

An auction design that has the potential to drag on for months or years is unacceptable. The loss of social welfare from such a delay would be huge relative to any imagined gain from delay. A good design would proceed in a predictable and timely manner, yet give the bidders time to react to new information.

Peter C. Cramton   4 January 1994

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Academic Positions	*Associate Professor of Economics* — Department of Economics, University of Maryland, since August 1993.
	National Fellow — Hoover Institution, Stanford University, September 1992 to August 1993.
	Associate Professor of Economics and Management — Yale School of Management, Yale University, July 1988 to August 1993.
	Assistant Professor of Decision Theory — Yale School of Management, Yale University, July 1984 to June 1988.
Education	*Stanford University*, Doctor of Philosophy, June 1984, Graduate School of Business. Concentrations in decision theory, game theory, and math programming. Dissertation: *The Role of Time and Information in Bargaining*.
	Cornell University, Bachelor of Science with distinction, May 1980, School of Operations Research and Industrial Engineering. Graduated first in class.
Courses Taught	*Negotiation and Competitive Decisions*. Developed for and taught in the MPPM program at Yale.
	Economic Analysis. Taught in the MPPM program at Yale.
	Quantitative Analysis for Management Decisions. Taught in the MPPM program at Yale.
	Theory of Choice II: Game Theory. Doctoral course in game theory with emphasis on information and dynamics.
	Advanced Microeconomics I. Doctoral course in the foundations of game theory.
	Theory of Games. An undergraduate introduction to modern game theory.
Research Interests	Bargaining theory, dispute resolution, incentives, contract theory, game theory, decision theory, auction theory, labor economics, industrial organization, experimental economics, information economics, and law and economics.
Honors	Hoover National Fellow, Hoover Institution, Stanford University, 1992-93.
	Winner of the *1984 Leonard J. Savage Thesis Award* for an outstanding dissertation in Bayesian Economics.
	American Assembly of Collegiate Schools of Business Doctoral Fellowship, 1983-84.
	National Association of Purchasing Management Scholarship, 1983-84.
	Dean's Award for Service to Stanford University, 1983-84.
	Finalist in *George E. Nicholson Student Paper Competition*, 1984.
	Two-time recipient of *Stanford Merit Fellowship*, 1981-83.
	Elected by the Operations Research faculty as outstanding senior, 1980.
Affiliations	Econometric Society, American Economic Association, Society for Economic Analysis, Society for the Promotion of Economic Theory, and Institute of Management Sciences.

Research Publications

"Wage Bargaining with Time-Varying Threats," (with Joseph Tracy), *Journal of Labor Economics*, forthcoming, 1994.

"Ratifiable Mechanisms: Learning from Disagreement," (with Thomas Palfrey), *Games and Economic Behavior*, forthcoming, 1995.

"The Determinants of U.S. Labor Disputes," (with Joseph Tracy), *Journal of Labor Economics*, forthcoming, 1994.

"An Agency Perspective on Relational Investing," (with Ian Ayres) in *Relational Investing*, edited by Ronald Gilson and Louis Lowenstein, Oxford University Press, forthcoming, 1994.

"Relational Investing and Agency Theory," (with Ian Ayres), *Cardozo Law Review*, forthcoming 15:4, 1993.

"Promoting Honesty in Negotiation: An Exercise in Practical Ethics," (with J. Gregory Dees) *Business Ethics Quarterly*, 3, 359-394, 1993.

"Strikes and Holdouts in Wage Bargaining: Theory and Data," (with Joseph Tracy) *American Economic Review*, 82, 100-121, 1992.

"Strategic Delay in Bargaining with Two-Sided Uncertainty," *Review of Economic Studies*, 59, 205-225, 1992.

"Dynamic Bargaining with Transaction Costs," *Management Science*, 37, 1221-1233, 1991.

"Using Auction Theory to Inform Takeover Regulation," (with Alan Schwartz) *Journal of Law, Economics, and Organization*, 7, 27-53, 1991.

"Shrewd Bargaining on the Moral Frontier: Toward a Theory of Morality in Practice," (with J. Gregory Dees) *Business Ethics Quarterly*, 1, 135-167, 1991.

"Cartel Enforcement with Uncertainty about Costs," (with Thomas Palfrey) *International Economic Review*, 31, 17-47, 1990.

"Nonrandom Mixing Models of HIV Transmission," (with Edward Kaplan and David Paltiel) in *Mathematical and Statistical Approaches to AIDS Epidemiology*, edited by Carlos Castill-Chavez, *Lecture Notes in Biomathematics Series*, Springer-Verlag, 218-241, 1989.

"Dissolving a Partnership Efficiently," (with Robert Gibbons and Paul Klemperer) *Econometrica*, 55, 615-632, 1987.

"Sequential Bargaining Mechanisms," in *Game Theoretic Models of Bargaining*, edited by Alvin Roth, Cambridge University Press, Chapter 8, 149-179, 1985.

"Bargaining with Incomplete Information: An Infinite-Horizon Model with Continuous Uncertainty," *Review of Economic Studies*, 51, 579-593, 1984.

Research Papers

"The Effect of Collective Bargaining Legislation on Strikes and Wages," (with Morley Gunderson and Joseph Tracy) Working Paper, University of Maryland, November 1993.

"The Use of Strike Replacements in Union Contract Negotiations: the U.S. Experience 1980-1992" (with Joseph Tracy) Working Paper, University of Maryland, November 1993.

Current Research

"The Effect of 'No Scab' Laws on Collective Bargaining" (with Morley Gunderson and Joseph Tracy).

"The Impact of Political Parties on Labor Policy, Wages and Strikes" (with Morley Gunderson and Joseph Tracy).

"Bargaining for a New Car: Theory and Evidence of Discrimination" (with Ian Ayres).

"The Effect of Outside Options on Strikes and Wages: Evidence from Canada" (with Bentley MacLeod).

"Outside Options and Strike Activity in Wage Bargaining" (with Bentley MacLeod and James Malcomson).

"An Attrition Model of Elections: Theory and Data" (with John Ferejohn).

"Skills vs. Knowledge: Destructive Conflict or Creative Collaboration in Management Education" (with Catherine Durnell Cramton).

"Can Informational Differences Explain Costly Disputes? An Experimental Study of Bargaining with Private Information" (with Joseph Tracy).

Research Grants

"Applying Strategic Bargaining Models to Union Contract Negotiations," National Science Foundation, April 1992 to March 1994, $177,760.

"Strikes and Delays in Wage Bargaining: Theory and Data," National Science Foundation, April 1990 to March 1992, $153,407.

"Gaming Exercises in Negotiation and Dispute Resolution," National Institute of Dispute Resolution, July to August 1988, $6,000.

"The Role of Time and Information in Bargaining," National Science Foundation, July 1986 to June 1988, $40,000.

"Public Sector Cases on Negotiation," Mellon Foundation, July to August 1985, $12,000.

Referee For

American Economic Review	American Political Science Review
Cambridge University Press	Econometrica
Economic Journal	Games and Economic Behavior
Group Decision and Negotiation	International Economic Review
International Journal of Game Theory	Journal of Business
Journal of Conflict Resolution	J. of Economics and Management Strategy
Journal of Economic Theory	Journal of Labor Economics
J. of Law, Economics, and Organization	Journal of Political Economy
Management Science	Marketing Science
MIT Press	National Institute for Dispute Resolution
National Science Foundation	Omega
Operations Research	OPSEARCH
Quarterly Journal of Economics	Rand Journal of Economics
Research in Experimental Economics	Review of Economic Studies
Scandinavian Journal of Economics	Science
Social Choice and Welfare	

Personal